

SR 520 Trail Grade Separation at NE 40th Street



APWA Project of the Year Submittal
Category: Transportation
Division: \$5 Million, but less than \$25 Million

Project Background and Introduction

NE 40th Street is a major arterial roadway within the Microsoft campus that provides the public, including Microsoft employees, access to work, State Route (SR) 520 expressway, transit, a future light rail station, and the SR 520 Bike Trail. NE 40th Street is heavily used by motor vehicles, buses, pedestrians, and cyclists and is often congested.

The SR 520 Bike Trail is a regional bike and pedestrian facility that connects downtown Redmond not only to Microsoft, but also to the University of Washington and eventually downtown Seattle, once all of the SR 520 expressway improvements are completed.



In its original configuration, the SR 520 Bike Trail crossed NE 40th Street at the signalized intersection of the SR 520 westbound on-/off-ramps and NE 40th Street. The crossing was the west leg of this intersection. The 164-foot-long crossing length required cyclists and pedestrians to cross eight lanes of roadway.

The City of Redmond (City) had two issues that needed to be addressed: a long at-grade crossing and high pedestrian/cyclist volume street crossings. The City led a team of consultants to deliver a new 110-foot-long bike/pedestrian tunnel under NE 40th Street. This configuration of a grade-separated facility helped achieve the project goals:

- **Reduce Congestion** – Crossing length and high pedestrian/cyclist volumes resulted in higher traffic delays (approximately 50 seconds) at this signalized intersection causing heavy congestion, especially at the beginning and the end of each workday. The tunnel provides an alternative for pedestrians and cyclists to cross NE 40th Street that does not impact traffic operations. Reducing the number of at-grade crossings reduces traffic delays, resulting in less traffic congestion.
- **Improve Safety** – Due to the long crossing, the pedestrian/cyclist exposure time to motorized vehicles created a greater potential for safety incidents. The City wanted to reduce this exposure. The tunnel helps eliminate the exposure of cyclists and pedestrians to motorized vehicles, which improves safety both for them and for motorized users.

The City selected David Evans and Associates (DEA) to lead the design and Granite Construction won the construction contract.

Construction Management

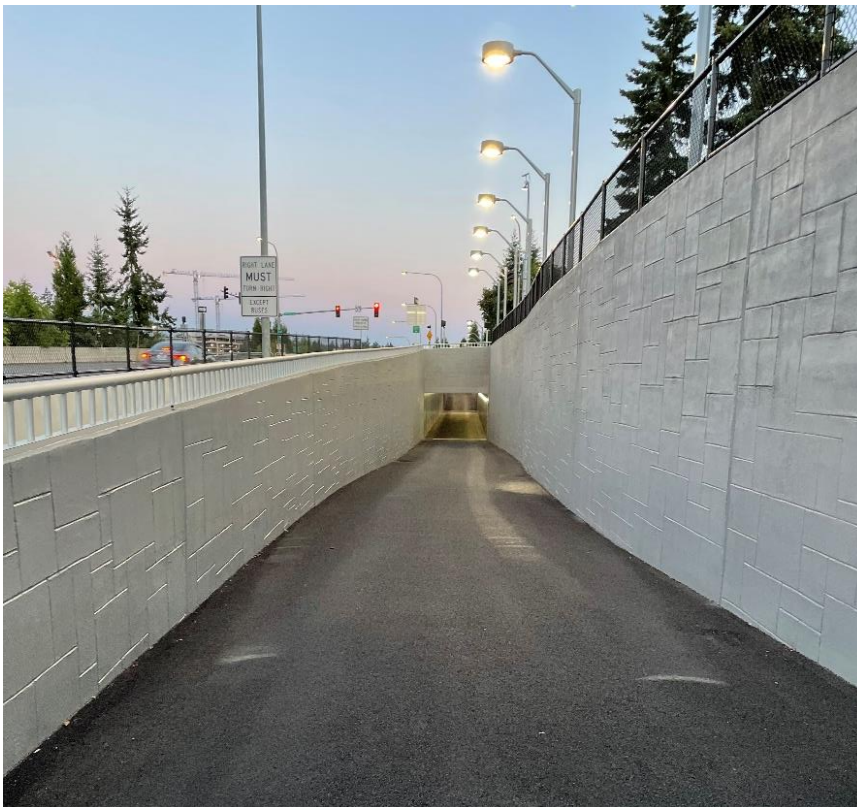
Design Project Schedule

Communication was essential in developing a project that met the City's and the public's goals and needs. To keep the project on schedule, DEA and the City used weekly project development team meetings that allowed them to quickly address project challenges. These challenges included uncertainty related to existing utilities; transit coordination; imminent Sound Transit light rail construction; and the need to minimize impacts to motorized vehicles, transit, pedestrians, and cyclists.

Construction Project Schedule

Project Team Coordination – The project team, which included the City, Granite, Microsoft, and other stakeholders, met on a weekly basis to discuss the upcoming schedule, concerns, and coordination. A major part of this coordination revolved around utilities and ensuring all parties understood the plan and how the work would be completed without impacting the critical infrastructure.

Scheduling – The project team utilized detailed 3-week look-ahead schedules that were actively used by all parties to coordinate work and communicate upcoming needs, or manage issues. Additionally, an hour-by-hour schedule was used to manage the 17-day closure and was shared with all stakeholders and contractors involved in the work to ensure timelines were achieved and responsibilities understood during this critical stretch. Through thorough advanced planning, including potholing, the closure was completed in 15.5 days, opening ahead of schedule.



Issue Resolution – The project faced challenges and issues along the way that were resolved by all parties having a project-first approach. This included managing through COVID-19, slab girder supply, utility conflicts, architectural tile design, and other on-site issues. All issues were resolved at the project level allowing work to progress and the schedule to be maintained.

Value Engineering Cost Proposal (VECP) – The approach walls to the tunnel were detailed as soldier pile walls with cast-in-place fascia with an ashlar stone finish. Granite developed a VECP to change the fascia to a shotcrete system. This no-cost change allowed the trail to be paved earlier and saved two weeks in project schedule.

Safety

Designing a Safe, Alternative Non-Motorized Transportation Facility

Safety was a critical design criterion for the tunnel grade separation structure and was always at the forefront during design. By following the principles of Crime Prevention Through Environmental Design (CPTED), the DEA design team incorporated the following key elements:

- **Providing a straight line of sight along the trail** – The tunnel's horizontal and vertical alignments were designed so trail users can see the entire length of the tunnel and approaches, which avoids hidden places and promotes security to tunnel users.
- **Creating a well-lit trail without shadows** – The project includes trail and tunnel lighting to avoid dark spots along the trail.
- **Minimizing the tunnel length** – Working closely with the City, Microsoft, and WSDOT, the team studied various tunnel lengths selected the length based on the back-of-sidewalk to back-of-sidewalk distance along NE 40th Street.



Safety Performance During Construction

Worker Safety – Granite held weekly safety briefings with all construction personnel. With nine months of construction and over 21,800 manhours, the project had zero recordable incidents – a significant feat considering working under operational utilities, the narrow and busy work corridor, deep excavation, and wall risk.

COVID-19 – Project construction began shortly after the onset of the COVID-19 pandemic and the project team worked together to implement a safety work plan and protocols to protect the employees. Due to strict adherence to the plan, the project was completed with zero COVID cases.

Police and Emergency Services – Police and emergency services were updated on construction regularly to ensure that emergency routes remained open at all times. Police services were used to direct traffic for work at signalized intersections.

Traffic Control and Public Safety – During construction, extensive coordination with WSDOT, the City, and Granite for work at signalized intersections was necessary to implement traffic control plans that minimized impacts to the traveling public. The project team identified a detour around the project site that maintained pedestrian traffic without exposure to project hazards while minimizing inconvenience. Granite frequently had traffic control personnel providing pedestrian escort during

work hours to maintain pedestrian safety. With the use of the approved traffic control plans, no construction-related vehicle accidents were experienced during construction of the project.

17-Day Full Closure of NE 40th Street

The contract documents allowed for a 17-day full closure of NE 40th Street for tunnel construction. This full closure shortened the tunnel construction period of approximately three months and provided a safe environment for the construction of the tunnel.



Tunnel Lid Construction – Constructing the tunnel lid presented safety challenges while setting precast lid sections under supported utilities with minimal clearances. To mitigate this risk, the team developed an innovative technique using rollers to slide panels under the utilities to minimize pinch points to craft employees.

Fall Hazards – During excavation of the tunnel and throughout construction, there were changing fall hazards. Although originally identified as a hazard, Granite constantly reevaluated the hazard as the depth of the excavation changed, utility supports were installed, and lagging walls were completed.

Utility Work within the Tunnel – Storm drainage was installed after the tunnel was completed, which confined the space. The team used large fans to blow clean air through the tunnel and monitored the space where equipment was operating.

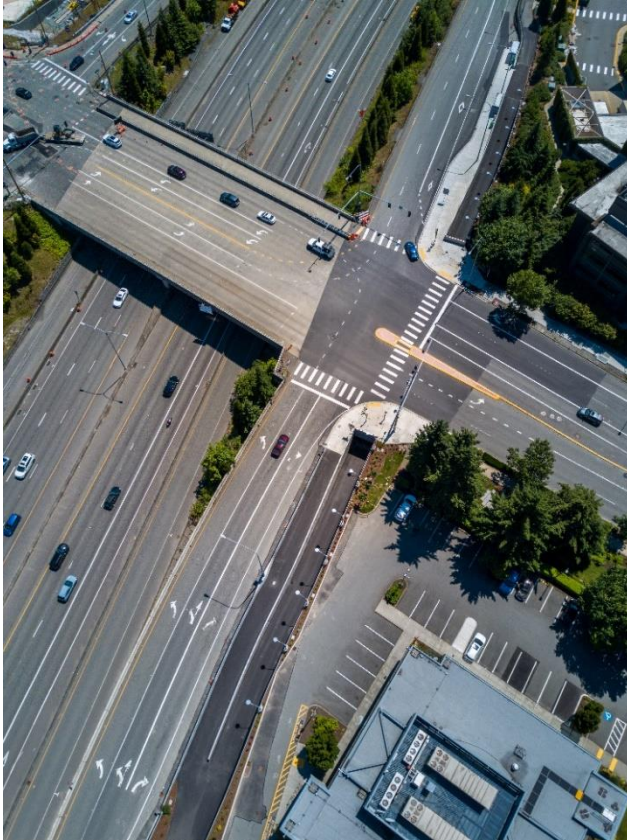
Confined Work Zone – The work area’s footprint fell within a 900-foot long by approximately 14-foot wide rectangle. Multiple subcontractors worked concurrently with Granite’s team in a very limited space. Diligent work planning and constant communication between all parties was a key part of the safe and successful completion of this project.

Community Relations

Reducing Traffic Disruptions to the Traveling Public

Given that the project location is at the main access to Microsoft, the DEA team extensively studied ways to minimize traffic impacts and disruptions. The installation of the tunnel had the potential to have a high impact on NE 40th Street traffic, transit services, and access to Microsoft. Based on pre-COVID level traffic volumes, the design team developed a detailed tunnel construction schedule for two NE 40th Street closure scenarios: (1) partial/nightly closures and (2) a full 24-hour closure. The design team obtained input and feedback on tunnel construction and production rates from the City, WSDOT, tunnel experts, contractors, and former contractors. Using this data, the team was able to recommend that a full 24-hour closure for 17 days would have the least impact on traffic, transit services, and Microsoft access.

Measures for Overall Safety of the Workers and General Public



Various communication platforms were used to keep the neighboring businesses, public, police, and emergency services updated on construction activities. The updates provided information regarding expected contractor activities, hours of work, and traffic control measures, including delays and closures. The City and Granite used the following platforms to provide information to the public:

- The City's SR 520 Trail Grade Separation website
- Weekly project updates on the City's news website
- The City's social media (Twitter and Facebook) and email announcements
- VMS boards and detour signs

In addition, City staff provided regular email communication regarding construction activities with Microsoft and adjacent construction projects like Sound Transit light rail construction and Microsoft Refresh projects.

Environmental Considerations

Environmental Considerations During the Project

During the design and construction of the project, one concern was limiting the removal of trees surrounding the project site. Results of a tree survey that determined tree species, diameter, and dripline were used to keep removal of trees to a minimum and only small diameter trees were impacted. Many trees were able to be salvaged by minimizing the footprint of clearing and saving the tree root systems.

Providing a Sustainable Outcome for the Surrounding Community

The construction of the tunnel provides SR 520 Bike Trail users an alternative to cross NE 40th Street, reducing vehicular delays at the intersection of NE 40th Street and SR 520 westbound on-/off-ramps, which in turn reduces air pollution. The project reduced the number of calls by pedestrians and cyclists to cross NE 40th Street, thereby resulting in a reduction in the number of vehicles and the wait time at a red light, which in turn reduces air pollution.

Unusual Accomplishments Under Adverse Conditions

Constrained Site

The project is constrained by the SR 520/NE 40th interchange and its associated ramps, bridges, and retaining walls, as well as infrastructure of the Microsoft campus.

The existing SR 520 Bike Trail is about 14 feet wide and is constrained between SR 520 westbound lanes and the Microsoft campus. The new trail, including the tunnel, is 16 feet wide. The proposed trail alignment originally followed the existing trail but was shifted to the west, because alignment needed to be maintained to retain a connection between the SR 520 Bike Trail and NE 40th Street. The maximum project footprint was approximately 30 feet wide. The following factors were constraints on the project footprint:

- WSDOT requested that the project have no impacts to SR 520 westbound operations.
- Microsoft needed to maintain the number of its parking stalls.



The construction of the new SR 520 Bike Trail required excavating the existing ground to create a trench for approaching the tunnel from both sides. The design team evaluated retaining wall types that could be constructed in this narrow footprint and selected a soldier pile wall system. The advantages of the soldier pile walls were: the narrow wall footprint (only three feet wide), the ability to be constructed in a narrow trail footprint, no permanent easements being needed from Microsoft, and minimization of risks and conflicts with adjacent utilities and infrastructure.

Retaining Wall Concept

The grade separation project had multiple retaining walls along the trail. Due to site complexities, including the constrained site and large quantity of existing utilities, cantilevered soldier pile walls were designed for the four approach walls leading up to the tunnel grade separation. The maximum height of these walls is 20 feet, which is taller than the height normally considered in the industry for cantilevered soldier pile walls. However, the use of ground anchors to tie the wall or the use of a different wall system posed challenges to construction, conflicts with the existing infrastructure on-site, and potential additional interagency coordination and permits. Therefore, the cantilevered soldier pile walls were designed to optimize the balance of the pile spacing and pile section size needed.



For the taller wall sections, tighter spacing and larger piles were used, while shorter sections used a different spacing and pile size to reduce project costs. Discussions with regional general contractors and steel fabricators about this design helped to confirm the construction efficiency, feasibility, and construction costs. The use of soldier pile retaining walls was beneficial because there were no conflicts with the soldier piles during construction, they provided efficient construction operations, and the soldier piles were easily procured, resulting in no delay or disruption to the project.

A section of the utilities was placed in a monolithic concrete encasement, which was unknown and not fully understood until the closure was underway. This required adjustment to the utility support plan and excavation methods on the fly. The project team had contingency plans included in the work plan and were able to utilize those to maintain progress.



Tunnel Artwork

The intricate design of the custom mosaic tile artwork required careful installation given the more than 5600 square feet of tunnel walls and ceiling covered by more than 800,000 tiles. Delays in tile delivery caused installation to occur during the winter months. Granite enclosed both tunnel ends and provided interior heating so the tiles could be installed per design requirements.



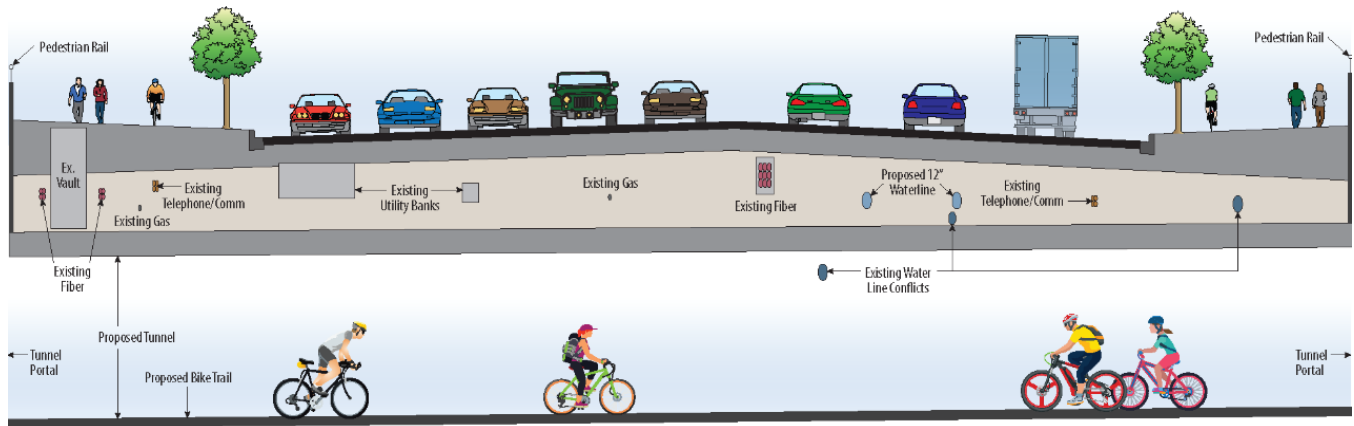
Additional Conditions

Tunnel Concept

The project included a tunnel consisting of precast, prestressed slab girders supported on soldier piles. The soldier-pile-supported structure was beneficial because the soldier pile wall substructure doubled as temporary shoring, limiting the amount of additional excavation and utility exposure during construction. It also provided efficient construction operations given that the adjacent retaining walls were also using drilled soldier piles. The precast, prestressed slab girder superstructure was precast off-site, making the pile cap the only cast-in-place element that needed to be constructed during the full closure of NE 40th Street. The slab girders were erected adjacent to each other, so that the bottom formed the tunnel ceiling but also expedited the backfilling of the tunnel for roadway construction, greatly reducing the construction schedule and impacts to the public.

Extensive Utility Exploration

NE 40th Street is a critical east-west utility corridor in the Overlake area, especially for telecommunications and power among the Microsoft buildings on both sides of SR 520. Other underground utilities include a gas main, two water mains, and a sanitary sewer. Several of the telecommunication, fiber, and power lines contained multiple conduits, up to 10 in one instance, and all encased in normal strength concrete.

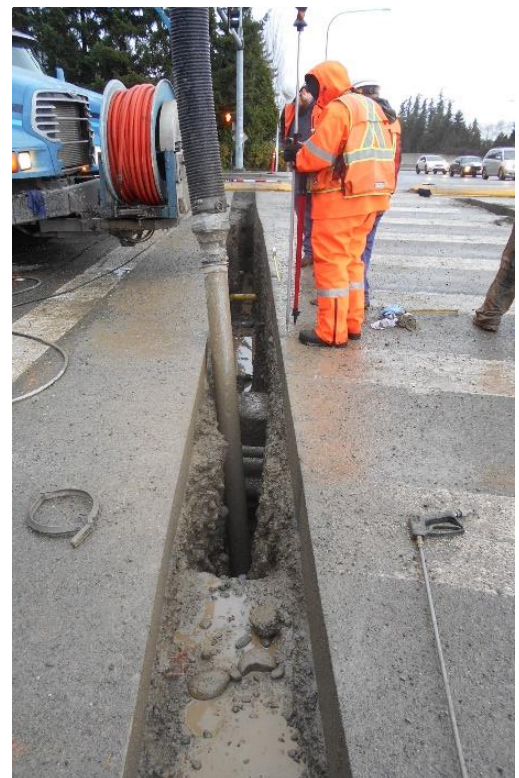


During design development, the team performed extensive utility exploration using ground-penetrating radar, traditional potholing, and trench potholing. The trench potholing included excavating two trenches across the NE 40th Street roadway in line with the proposed soldier pile locations. The design team was able to create a 3D underground model of the utilities. Using this data, the team confirmed that the proposed pile location and the top of tunnel would not conflict with the existing utilities.

In addition, the team used this data to develop contract special provisions and a cost estimate for the contractor's design to support all the concrete-encased utility banks during tunnel construction.

Conducting this extensive investigation of existing utilities provided two major benefits:

- In areas where this extensive investigation was performed, there were no construction change orders due to conflicts with soldier piles or top-of-tunnel construction. The City had set an assigned budget for these potential change orders. This investigation resulted in the City saving approximately \$2 million.
- There were no disruptions to Microsoft operations. There were no accidental utility cuts or damage due to the contractor's operations.



Interagency Coordination

A substantial portion of the project is within WSDOT ROW, which required close coordination with WSDOT by the project team throughout design and construction. Additionally, Microsoft owns property that is adjacent to the project to the west. The City and consultant team worked closely with WSDOT and Microsoft to discuss concepts, design elements, restrictions, and impacts. The collaborative efforts made the project successful in achieving the ultimate goal of the project while meeting both City and WSDOT design and construction standards.

Alternative Materials/Practices of Funding Demonstrating a Commitment to Sustainability

Protecting Existing Utilities

The project site is in the middle of a heavily developed area that includes a large number of existing utilities of all types. Design and construction had to navigate this vast network of utilities.

Existing utilities under NE 40th Street included communication fiber lines, power, gas, water, and sanitary sewer. Precise information on the locations and depths of these existing utilities was essential in designing the trail alignment/profile design and selecting the type of tunnel to construct. The team performed an extensive investigation of existing utilities using ground-penetrating radar, traditional potholing, and excavation of two trenches across the southern half of NE 40th Street. During construction, the existing conduits were protected and no damage occurred.

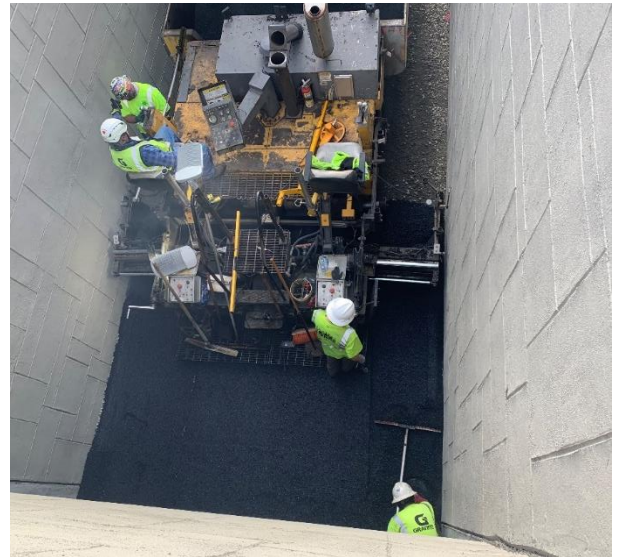


Reducing Air Pollution and Providing a Sustainable Route

The construction of the tunnel provides SR 520 Bike Trail users with an alternative to cross NE 40th Street, reducing vehicular delays at the intersection of NE 40th Street and SR 520 westbound on-/off-ramps, which in turn reduces air pollution.

Sustainability

- Asphalt used for the project contains 20% recycled asphalt
- Use of energy efficient LED lighting both inside the tunnel and along both tunnel approaches
- Reducing day-time lighting of the tunnel to every other light reduces energy consumption
- Reuse of some excavated materials behind soldier pile walls
- Composted mulch used for tree plantings



Summary

The project was constructed during the pandemic with no COVID cases and zero recordable safety incidents, all while working in a restricted space and under live utilities. The 17-day full closure for the cut-and-cover tunnel reduced impacts to the traveling public and allowed the tunnel to be constructed in a shorter amount of time.

The project goals were to improve safety and reduce congestion. Vehicles, cyclists, and pedestrians are experiencing increased safety because trail users needing to cross NE 40th Street can do so through the palm tree-and-rainbow lined tunnel. The reduction in wait time for vehicles at the intersection due to fewer cyclists and pedestrians crossing NE 40th Street at grade, has reduced congestion and pollution from idling cars.



Funding:

Connecting Washington: \$12,407,579
Community Facility District: \$1,494,352
Transportation CIP: \$360,000

Design Start: June 2016

Construction Start: May 2020

Substantial Completion: May 2021

Physical Completion July 2021